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EVALUATION REPORT

Bell Model 204B Helicopter



PREPARED FOR
UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
NORTHERN CALIFORNIA SERVICE CENTER
AIRPORT ROAD REDDING, CALIFORNIA



United States
Department of
Agriculture



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EVALUATION REPORT - BELL MODEL 204B HELICOPTER

During the week of July 22 to 26, 1963, evaluation flight testing was conducted at the Northern California Service Center, Redding, California. The flights were conducted with the cooperation of the Bell Helicopter Company and the United States Forest Service. Flights were to determine the feasibility of the 204B Helicopter for Forest Service operations. These evaluation flights were conducted primarily with fire control operations in mind. Tests were not to determine the maximum payload or all the conditions that would be present under general Forest Service operations. The 204B Helicopter could also be used for timber management and engineering projects.

F.A.A. certified performance data information is available and contained in the F.A.A. Approved Flight Manual furnished with each 204B Helicopter. Performance data information includes performance at a range of altitudes, temperatures and payloads that preclude the necessity for further substantiation. The flexibility and utilization of the larger 10-12 place Bell Model 204B Helicopter was readily ascertainable and would contribute to present fire control procedures as presently F.A.A. certified and delivered to commercial operators. Suggestions for further minor improvements and safety features consistent with fire control procedures are contained in Flight Evaluation Reports included herein.

The 204B Helicopter could be used for many assignments, such as initial attack when a helitack crew could be flown directly to the fire, landed and walk to the fire. Helijumping could also be done from this helicopter.

Smoke jumping could be accomplished from this helicopter, without any major changes. The sky-genie descent mechanism could be used in areas where neither a landing, helijumping or parachute jumping were feasible. This would give four methods of initial attack using one helicopter and a 6 to 10 man crew trained in all these specialties. Once the initial attack had been accomplished, the helicopter could be used to ferry reinforcements to the fire. The 204B Helicopter could ferry more men (10), faster than any present helicopter in existence. Its rate of climb also exceeds that of the smaller 2-4 place helicopters available to date. The combination of no warmup required of the jet engine, a high rate of climb, its increased airspeed of 138 m.p.h., coupled with a larger helitack crew (8 to 10) would greatly increase the effectiveness of an initial attack or response. The helicopter could also be used for ferrying cargo, both internal and external. The internal loads would not have to be packaged in any special manner for delivery. They could be dropped by parachute, pushed off with helijumpers, or unloaded at a helistop.

All four cabin doors can be removed and the ship can be loaded from both sides at once. Passengers or crew members can use all four door openings for ingress and egress. The passenger or aft portion of the cabin has 4-foot door openings on each side of the cabin, affording a rapid unloading of crew members from both sides simultaneously at fire location. Also, if necessary, long pieces of cargo could be placed in the cabin extending beyond both sides of the fuselage cabin, as both 4-ft. door openings are in line across cabin, and flown to the fire. External racks can be attached to the side of the helicopter on stressed lugs provided on

each helicopter, located on the fore and aft center of gravity. These lugs are capable of carrying 1,500 lbs. apiece. The ship can also carry sling loads on an F.A.A. approved pendulum type manual and electric type cargo hook available and installable on each 204B helicopter. The cargo hook was designed, tested and in daily use on Military 204B type helicopters. These loads can be prepacked so that the helicopter has only to hover over the load and with one movement pick up the entire load, fly it to the fire and lower it where it is needed. If a landing or touchdown area for the cargo sling were not available the entire cargo sling load could be released by parachute. This would cut down the amount of time that is required to load and unload; therefore, more efficiency could be obtained from the helicopter. Cargo could be loaded internally, externally, and on a sling and flown to three separate locations if necessary. Using these three systems, the cargo could be delivered on the line where no helispot is available by sling load; at a location where a helispot has not been completed by external racks, and on the heliport by means of internal load. Internal and external cargo can also be dropped by parachute in any quantity that is desired. With these various unlimited methods of cargo handling, It is impossible to visualize a fire where any other transportation would be required. The 204B Helicopter can also be used for removing injured persons in a litter or without litter. Three litters may be placed in the cabin at one time if necessary. The helicopter is also fast enough that in an emergency a ship can pick up a doctor and necessary supplies and be flown to the injured person without a great delay. The large cabin size also affords the space for a Doctor's Attendant to administer to the

injured in emergency cases while in flight.

An internal fire retardant fluid tank may be secured in the cabin with very little work, in a short period of time. This tank could be constructed so that the drop doors would extend past the cabin and the drops could be made simultaneously out of both sides of the helicopter. Preliminary estimates indicate that a 360 gallon tank could be used at an average elevation of 5,000 feet. The 204B helicopter, because of its size, could be used for an aerial reconnaissance conference on fires. On large fires, at present, considerable time is spent flying one or two overhead at a time in reconnaissance of a fire. With this helicopter the Fire Boss, Line Boss, and other fire overhead could be flown around the fire at the same time, mutual problems could be discussed and settled without extra effort. This would give the Fire Boss and his staff a better understanding of the fire with a minimum of time spent in the air. It would also decrease the number of flights that are now used for reconnaissance. During the demonstration flights at the Northern California Service Center, as many of the above-mentioned tasks were attempted as were possible with the limited amount of time and equipment available. These flights indicated that with minor modification the 204B Helicopter could do any job required of it. A service contract for the use of a 204B Helicopter on fire control work could serve to utilize the present unlimited capabilities of the helicopter and at the same time determine through actual field work the best applications of its uses and development of procedures and additional equipment modifications that might be required. These evaluation flights also indicated that the helicopter is capable of

generally doing four or five times as much work as the small helicopters are capable of doing at the present time. This means that instead of hauling one or two men at a time you can haul eight or ten men. The same is also true of cargo.

The actual contract costs per passenger and/or ton mile are not included in this evaluation. A rule of thumb basis, based on its capability to perform 4 to 5 times the work of the 2-passenger helicopter indicates an acceptable contract cost might be obtainable at four or five times the present passenger rates.

If costs were comparable, a bonus or added reason for use of the larger 204B Helicopter would include the following advantages:

1. More flexibility and greater coverage of on-the-spot utilization.
2. More rapid response with larger crew.
3. Reassignment to distant fire areas in view of increased cruise speed - 120-138 m.p.h.
4. Less air traffic in congested areas of fire.
5. Airtanker utilization - more complete control in areas not suitable for fixed wing operations.

Following is a comparative data study that was compiled for another agency who conducted a study of actual fire costs of airplane vs. helicopter retardant delivery costs per gallon. The 204B costs for the delivery of retardant are based on the manufacturer's estimated operating costs to the operator. The agency compiling the study adjusted the manufacturer's cost figures as necessary on the basis they would purchase and operate the 204B Helicopter.



COMPARATIVE DATA OF VARIOUS AIRCRAFT
AS APPLIED TO WATERSHED FIRE FIGHTING

	<u>Present Helicopter</u>	<u>Proposed 204B Helicopter</u>	<u>AJ-1 Air Tanker</u>
Cruising Speed	70 mph	110 mph	190 mph
Passenger Capacity	2	9	
Useful Load Per Trip	815	3,875	18,000
Direct Operating Cost Per Hr.	\$90	\$475	\$600
Gallons Retardant Delivered for Trip	60	365	2,000
Gallons Retardant Delivered per Flight Hour	1,200	10,950	5,000
Cost Per Gallon Delivered	.075	.036	.120
Fire Fighters Carried Per Hr.	40	270	
Hose Carried Per Trip	950' of 1 $\frac{1}{2}$ "	7,000' of 1 $\frac{1}{2}$ "	
Grips Needed to Set up and Fill Portable Pumping Unit	19	4	N/A
External Load Per Trip	490 lbs.	3,600 lbs.	N/A
Internal Load Per Trip	380 lbs.	3,000 lbs.	N/A
Availability for Administrative Construction and Emergency Assignment all Year	Yes	Yes	No
Rescue Hoist Operation	No	Yes	No

An important advantage of a larger helicopter is in the emergency evacuation of injured fire fighters. Victims are now carried outside on litters attached to the helicopter's landing gear. This arrangement precludes any type of first aid or assistance being administered enroute. The large machine allows for transporting victims inside the cabin, protected from the elements, where a doctor or first aid attendant can accompany them and assist as needed with plasma, breathing apparatus, etc. The above data is derived from findings contained in a report prepared by this department comparing estimated helicopter and actual fixed wing aircraft performance on selected watershed fires. Estimates of helicopter performance are based upon equipment specifications supplied by the Bell Helicopter Company.

HELIJUMPING - EVALUATION FLIGHTS

This flight was made to determine the feasibility of helijumping from the helicopter. The 204B Helicopter furnishes a large platform to work from in helijumping. The large doors on both sides make it easy for the helijumpers to get into position and when leaving the ship, the step-off is easy. The center of gravity is not effected by the movement of helijumpers inside the ship or when leaving the ship. The first flights were made over clear ground with one person jumping on each side. Later, a jump was made over brush with one person jumping on each side. The final flight was made over clear ground with four jumpers jumping at once, two on each side. The pilot could not feel the jumpers leaving the ship, nor did he notice any adverse effects on any of these flights.

On Flight No. 2, the helicopter lifted off with 8 jumpers. It made two passes over the jump zone. Four men jumped at each pass--two from each side. They jumped at the pilot's nod.

Comments:

The 204B seems to be ideal for helijumping, not only because of the large door, but because of the added safety in flight operation. You can also deliver more men more quickly, including tools and food, than you can with present helicopters.

The 204B offers asymmetric allowable loading of 60,000 in./lb. moment whereas the smaller 2-passenger helicopters are limited to 5,200 in./lb. The 204B larger asymmetric allowable loading is considered an important safety feature.

Hand holds or additional belts needed for jumpers.

Belt should be easier to unhook.

Evaluation Flights (cont)

PA system desirable for instructing jumpers.

Although one late jump occurred, no rocking was experienced.

He1i jumping

8 men

Wind - O-2 m.p.h.

Temp - 26° C. OAT

N-1 - 92-93%

WEIGHT

Jumpers' weights w/gear

Average Jumper Weight w/gear 188 lbs.

SMOKEJUMPER - EVALUATION FLIGHT

The parachuting demonstration flight was to determine if there was adequate clearance for the static line and bungee cover. The amount of delay in the opening of the parachute was to be observed along with the rotor clearance.

The first pass was a streamer pass to determine the wind and elevation above ground. The following pass, a dummy was dropped. The smokejumpers (2) were dropped following another streamer pass. Drops were made at 35 knots.

STATIC LOADING - EVALUATION ON GROUND

A study was conducted with fully clothed and equipped Smokejumpers to determine maximum number of Jumpers that could be carried.

Without seats, the maximum safe workable space within the rear section of the cabin is considered to be limited to six Jumpers. No supplies could be carried with 6 Jumpers seated on the floor and the Spotter seated in right seat in the forward section of the cabin. Supplies could be carried in a cargo sling net and parachuted after the Jumpers were down.

With seats inside and cargo carried as a sling load, it may be possible to carry eight Jumpers.

If Jumpers, Spotters, and supplies are all to be carried inside the rear cabin area, there is room for only 4 Jumpers. It would be desirable

Static Loading - Evaluation on Ground (con't)

to also have rear cabin section for the Spotter.

Supply boxes could be parachute dropped and carried in the cabin if the boxes were of a size and strength to act as seats for the Jumpers prior to their jump. The Spotter could drop the supplies boxed as seats, after the Jumpers were out.

Comments:

The static line and bungee cover did not foul on the helicopter. A system for spotting would have to be worked out. The helicopter should be flown in a crabbed position when Jumpers exit on left side, to offer additional safety clearance since the tail rotor is mounted on left side of the tail boom.

Jumpers commented that little or no shock was felt from chute blossom at helicopter speed of 35 knots.

PARACARGO DROPPING - EVALUATION FLIGHT

The helicopter cabin was loaded with eight standard 2-man crew supply boxes. The eight boxes did not fill the cabin area.

The helicopter lifted food and equipment for sixteen men for two days. There were two cargo pushers aboard. Streamers were dropped in first and second runs. The third drop was at 30 knots. One cargo box was dropped. The fourth time over the target, the cargo was dropped from a hover. On the fifth run, cargo was dropped from both sides. The speed was 25 knots. The rubber cup on the end of the static line hooked on the right skid. The sixth time over the target, the helicopter hovered and dropped cargo out of both sides. Both static lines stayed clear. The seventh run was made north to south rather than south to north as the previous ones had been. The speed was 45-50 knots.

Two cargo boxes were pushed out of the same side simultaneously, both chutes opened with no complications; they did not tangle.

Comments:

Static should be shortened so as not to wrap around tube.



Evaluation Flight (con't)

Paracargo

Two-day rations and equipment for 16 men
(8 standard boxes)

Wind 5-8 m.p.h.

Temp 28° C. OAT

N=1 90-91 %

PA 1,000

WEIGHT

W/E 4,875

Cargo 1,200



SLING LOADS - EVALUATION FLIGHTS

Water Tank and Pump - Skid Mounted

This flight was to determine the maximum sling load that could be lifted off the ground at a pressure elevation of 500 ft. The density altitude was 2,800 ft. The outside temperature on the ground was 36°C. For this flight, a 400 gallon coffin tanker was used. The weight of the tank, pump and skid was 1,000 lbs. In actual practice, this weight could be cut considerably, but for demonstration purposes this heavy tank was used.

The helicopter had no trouble picking the empty tank off the ground and flying it around the area. One thing was brought out, the fact that a man was needed to direct the pilot in picking the tank up and lowering the tank to the ground. The sling load handled best between 40 and 50 knots. Forward speed was limited by the buffeting of the tank. There was no problem in controllability for the pilot. The U.S.F.S. nylon sling harness presented a problem because of the stretch factor. Center of gravity was not effected during the flights.

Comments:

For field operations, the type of sling harness to be used would have to be one that would not present a problem in stretching. The trailing angle of the sling load is also an important factor. This would have to be determined through experimenting with various load sizes and shapes.

Water Tank and Pump (con't)

U.S.F.S. Nylon Sling Harness

Density Altitude - 2,800 ft.

Outside Temperature - 36° C.

Weight of Helicopter empty - 4,940

	Power Setting N-1	T/Pipe Temp.	OAT
Flight I	93%	520° C	35° C
Flight II	94 $\frac{1}{2}$ %	540° C	35° C

FLIGHT I

Pilot Weight	340	
Oil	30	
Fuel	800	
Tool Box	40	
	<u>1,210</u>	1,210
Coffin Tanker	1,000	
50 gals. water	415	
	<u>1,415</u>	<u>1,415</u>
Total weight of load		<u>2,625</u>

FLIGHT II

Pilot Weight	340	
Oil	30	
Fuel	800	
Tool Box	40	
	<u>1,210</u>	1,210

Sling load increased 415 lbs.
(Total water - 100 gals.) for
a total weight of ...

1,830
3,040



Water Tank and Pump (con't)

If the helicopter weight empty was adjusted to standard configuration less cabin doors and not over 1 hour of fuel, the increase in water that could have been carried would be 100 gallons additional, or a total of 200 gallons at time tank was carried.

Based on useful load of 3,040.0 pounds -

Weight saving - standard configuration	340.0
Less - Co-Pilot	170.0
Less - Adjusted Fuel Load	300.0
Less - Tool Box	40.0
Less - 4 Cabin Doors	<u>86.0</u>
Total lbs. Gain in Payload	736.0

Water Tank and Pump (con't)

Evaluation Flight No. 2 - Using Aeroquip Sling Harness

The helicopter lifted off with a sling loaded 500 gal. coffin tank with 100 gal. of water. The load did not oscillate or otherwise cause trouble. The helicopter circled the airport attaining a speed of 70 knots. The pilot later estimated 80 knots as peak comfortable airspeed with such a load. A stronger and more firm cargo sling harness was used for this flight. The front straps were two feet longer than the rear straps so that the load would ride lower in front.

Comments:

A convex type mirror is needed to allow the pilot to see the cargo as well as the hook.

It is mandatory to have a man on the ground directing the cargo letdown.

A man with a radio is best.

Sling harness should have a swivel at cargo release hook.

Harness manufactured by the Aero-Quip Corporation, Jackson, Michigan felt better than the U.S.F.S. nylon sling.

Evaluation Flight No. 2 (con't)

Wind	-	3-5 m.p.h.
Temp.	-	27° C (OAT)
N-1	-	93%
PA	-	500

WEIGHT

Cargo

Tank & Pumper	1,000			
100 gal. of water	<u>850</u>			
	1,850	...	<u>1,850</u>	
			7,743	1bs.

CARGO NET

Evaluation Flight No. 3

The helicopter lifted a 1,200 lbs. load of 8 boxes of supplies, hovered for a moment and circled the airport. Top comfortable speed was 55 knots. The cargo was a two-day supply for a 16 man crew. The load was carried with an Aero-Quip nylon net cargo sling. (160 dollars from Aero-Quip). More supplies could be carried in larger cargo net.

Comments:

Nylon sling has too much resiliency, caused bouncing of cargo. Could have carried 4 to 5 passengers along with sling load.

Larger cargo nets would allow carrying supplies for 32 men for 2 days.

Evaluation Flight No. 3

Sling Load

Wind - 3-5 mph

16-man, two-day supply

Temp. - 23° C OAT

WEIGHT

W/E	4,875
Fuel	500
Oil	28
Pilot	170
Co-Pilot	170
	868
Cargo	1,200
	6,943 lbs.



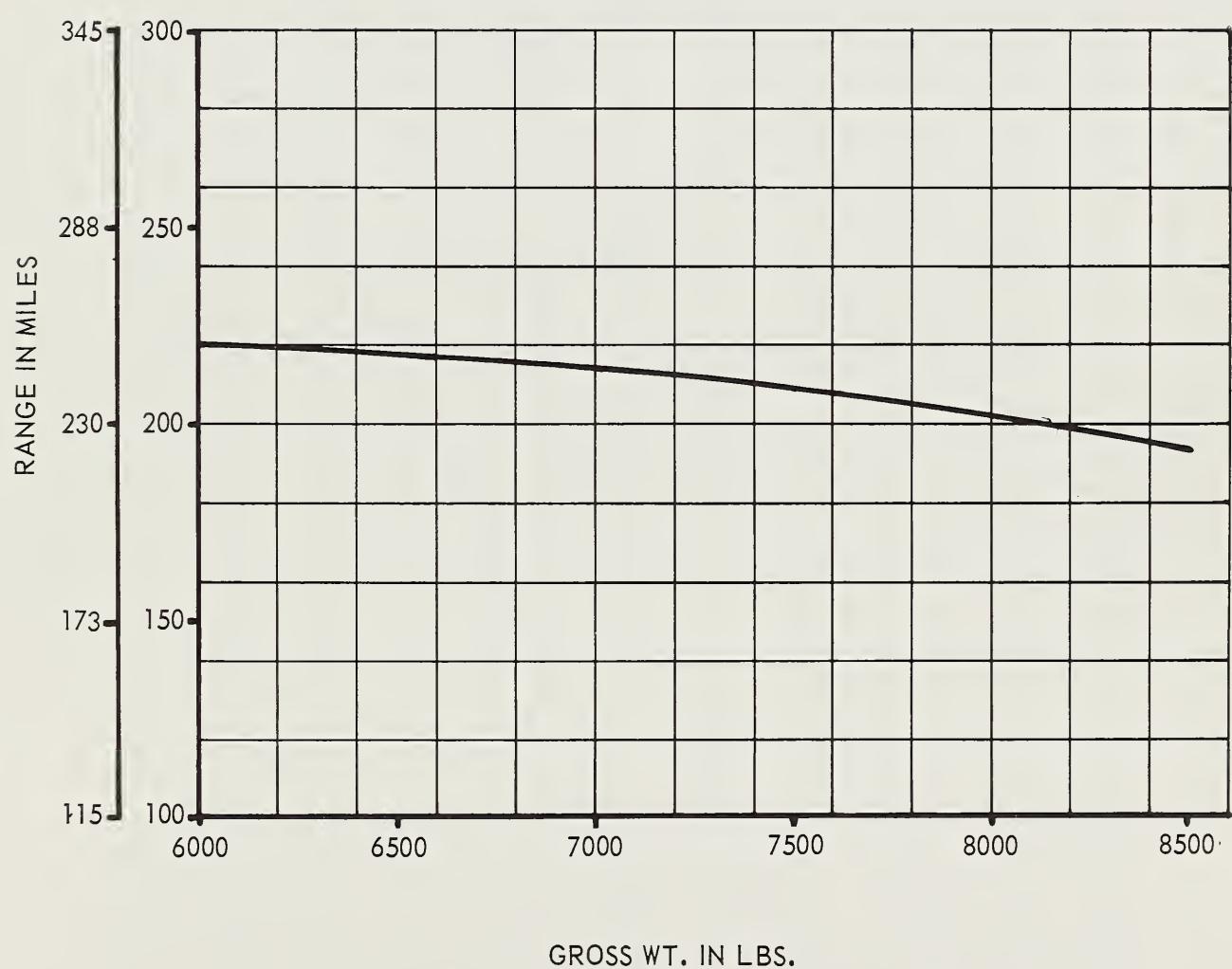
P E R F O R M A N C E D A T A

Bell Model 204B Helicopter

Gross Weight, Part 7 Cat.	8,500 lbs.
Weight Empty, Standard Configuration	4,600 lbs.
Useful Load	3,900 lbs.
Engine (Lycoming T5309C)	
Take-off Power	1,100 H.P.
Continuous Power	900 H.P.
Fuel Capacity	165 gal.
Maximum Speed	138 mph
Cruise Speed	120 - 138 mph

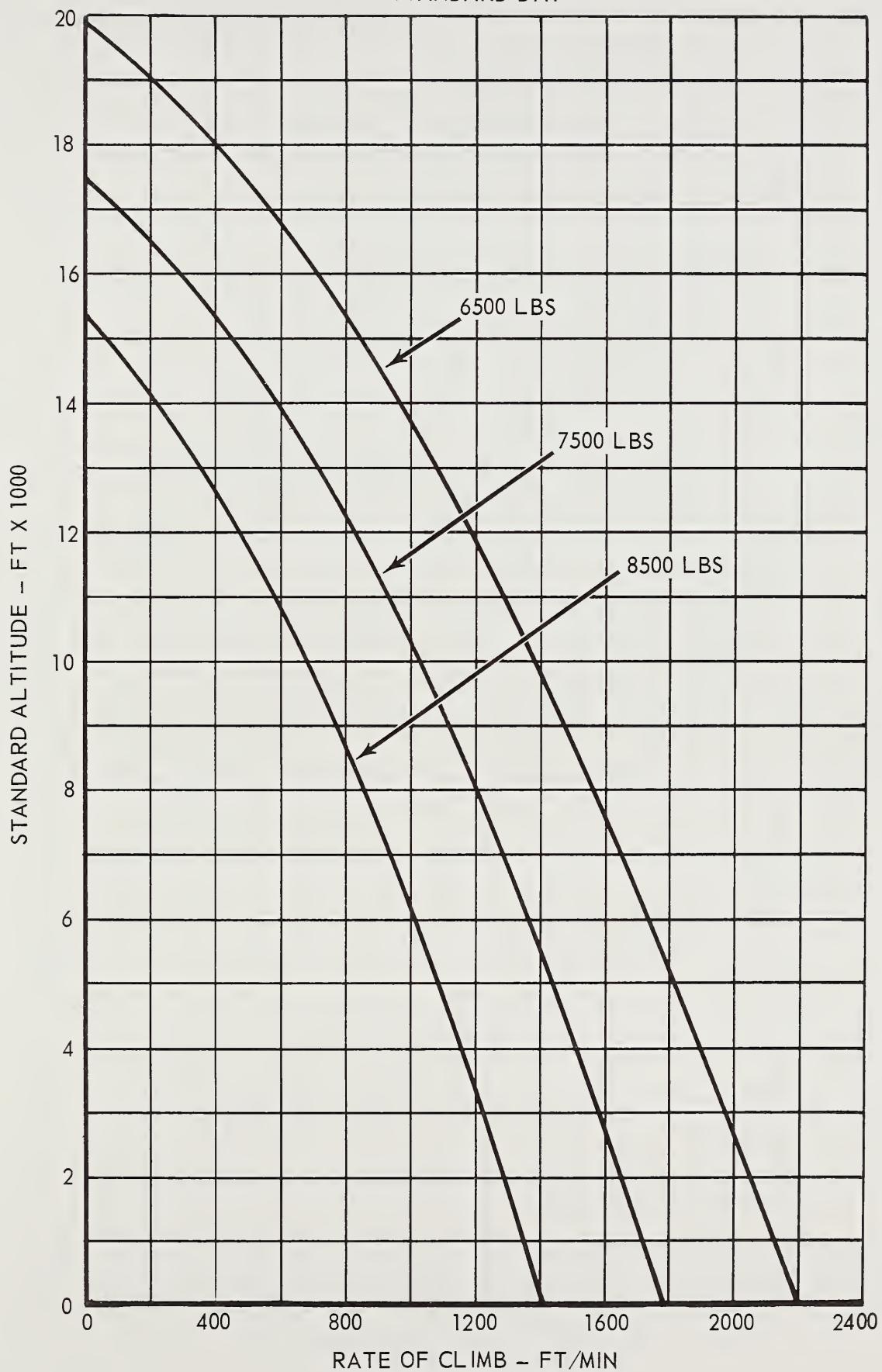
BELL MODEL 204B

GROSS WEIGHT VS RANGE
FULL FUEL OF 1072 LBS.
INCLUDES 10% RESERVE
5000' STANDARD DAY
6200 RPM



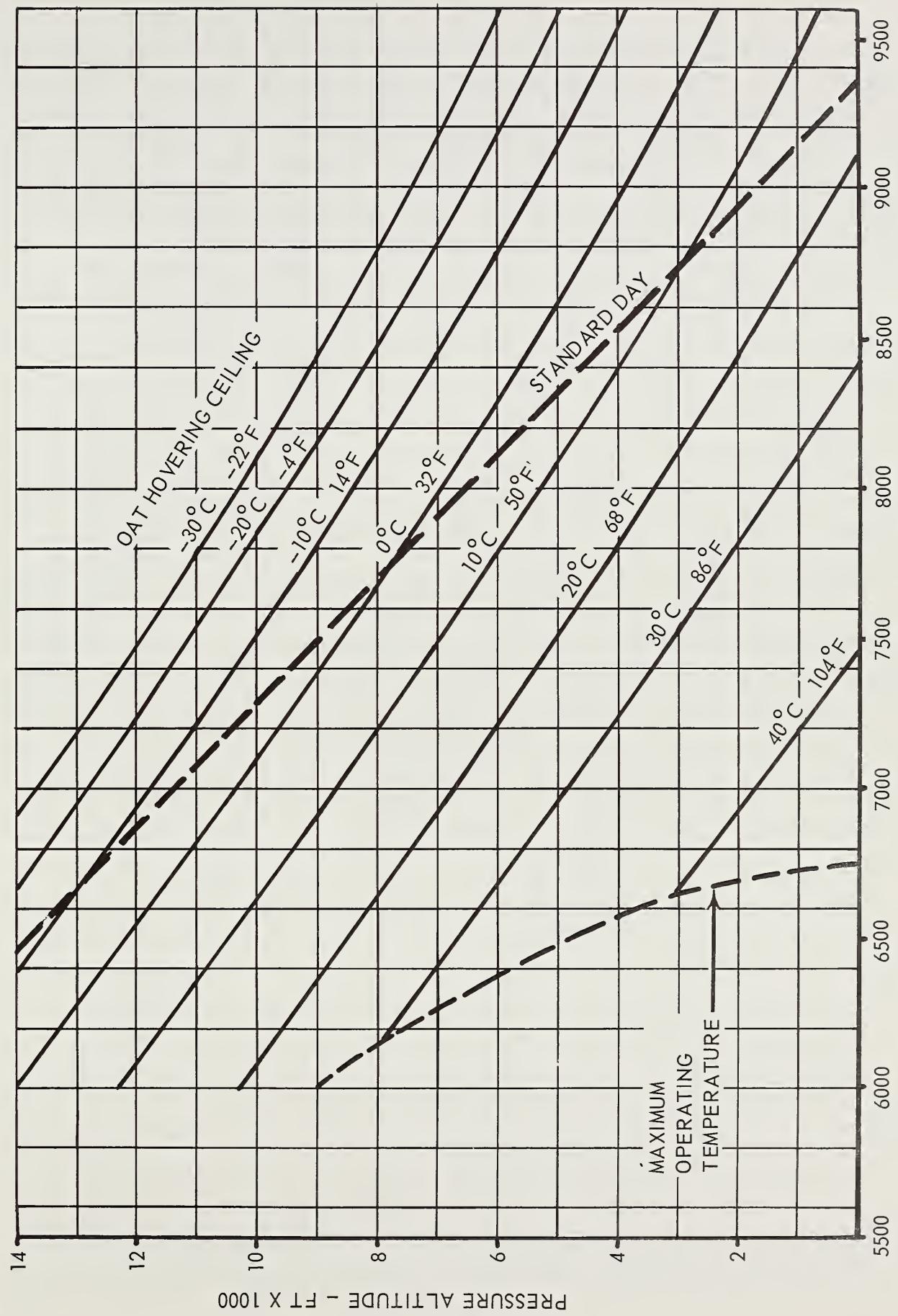
BELL MODEL 204B
RATE OF CLIMB

TAKE-OFF POWER - 6600 RPM
STANDARD DAY



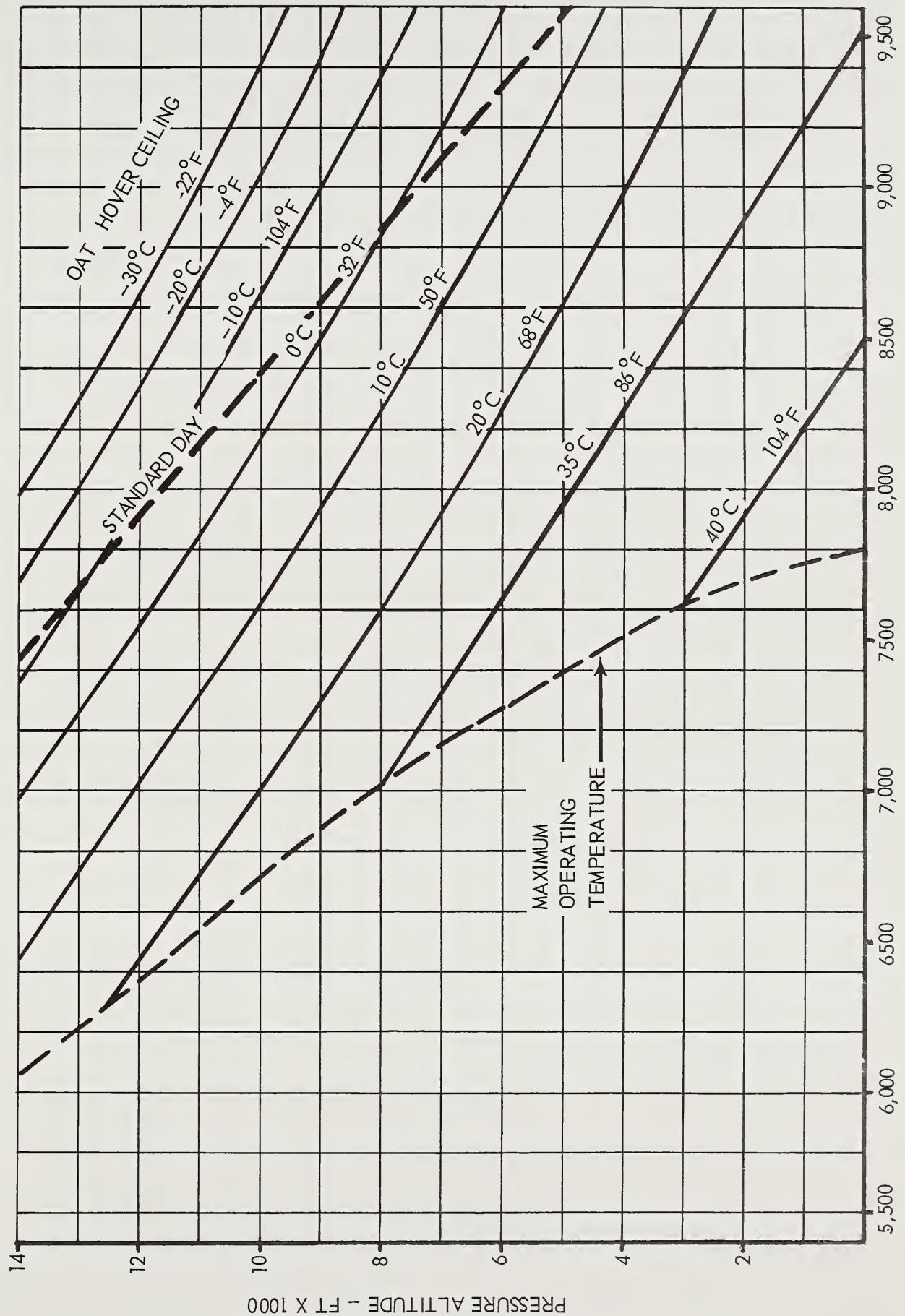
BELL MODEL 204B

HOVERING CEILING OGE
AVAILABLE TAKE-OFF POWER @ 6600 RPM



BELL MODEL 204B

HOVERING CEILING IGE
AVAILABLE TAKE-OFF POWER @ 6600 RPM





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